The Role of Pollen Source in Improving Fruit Quality and Yield of Date Palm cv. Piarom

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Summary

This study was conducted to investigate the effect of pollen source on the quantitative and qualitative characteristics of the Piarom cultivar. Five treatments, including male date palms (cvs. Spake, Meskotan, Fanoj, Grambit, and Zaboli), were used on twenty 15-year-old cv. Piarom date palm trees in a complete randomized block design with four replications in one of the commercial orchards in Bampour city during 2021-2022. The physical properties of the fruit were measured, which included time of fruit ripening, fruit set, parthenocarpic fruits, fruit drop, the length and diameter of the fruit, the volume of the fruit, the length and diameter of the seeds, the weight of the seeds, the weight of pulp, the fruits bunch^{-1} weight, the weight of parthenocarpic fruits, bunch weight and the yield. The results showed that the pollen grains had significant differences in fruit formation, fruit drop, fruit length, diameter, weight and volume, seed length and diameter, bunch weight, fruit flesh weight, soluble solids content and yield. Among the male parent pollens, Fanoj and Zaboli had the highest fruit formation (57.24 and 57.15 %, respectively) and the lowest fruit drop (34.33, and 33.63%, respectively), whereas Grambit had the highest fruit weight, volume, length and diameter. Cvs. Zaboli and Fanoj also had the highest bunch weight. Moreover, the yield per tree using cvs. Zaboli and Fanoj male parent pollens was 64.1 and 62.5 kg, respectively. Based on the results of this study, the use of cvs. Zaboli and Fanoj male parent pollen for the pollination of the cv. Piarom is recommended to increase the percentage of fruit formation, bunch weight and yield as well.

Key words

Phoenix dactylifera L., metaxenia, pollen grain, pollination, yield

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Introduction

In hot and arid regions across the world, the date palm (*Phoenix dactylifera* L.), commonly recognized as the most ancient and widely favored fruit tree, holds a prominent status. It is especially prevalent in the Gulf countries of the Middle East (Saleh et al., 2011). The date palm is a dioecious tree from *Arecaceae*, which has 200 genera and 2500 species (Ben Amor et al., 2014; Eoin et al., 2016). Date production covered an area of 1,396,727 ha and world production reached 9,248,033 t in 2019 (FAO, 2021). As the date palm is resistant to drought, salinity, cold and heat, it plays an important role in food security and the preservation of the environment. Considering the limitation of production by increasing the cultivation area and preventing an increase in costs, there is no other way to increase performance per unit area. It is possible to increase the quantity and quality of date palm fruits per surface unit by conducting research and implementing agricultural and racial measures. Since date palm is a dioecious plant that needs pollination to form the fruit, and the effect of pollen on the quantitative and qualitative characteristics of date palm fruit has been proven in numerous reports, it is very important to choose a strong, healthy, and high-quality pollinating tree cultivar. In other words, the genetics of the pollinator cultivar and its compatibility with the female cultivar play an important role in the success of fertilization and fruit formation, which is known as the phenomenon of metaxenia (El-Sharabasy and El-Banna, 2009).

The yield is increased by choosing a suitable pollen source (Dawson, 1982). Within date palm orchards, pollination plays a pivotal and intricate role, as it holds immense significance in influencing fruit production. It not only affects the yield, but also enhances its quality (Al-Khalifah and Askari, 2011).

Several studies have revealed that both the production and quality of dates are affected by the source of the pollen grains (Khamis et al., 2010; Outghouliast et al., 2020; Zargari et al., 2023). The findings of one study revealed notable impacts of pollen type on two female date palm cultivars, specifically the tissue culture-derived cvs. Barhi and Piarom (Zargari et al., 2023). Another study discovered that the characteristics of cv. Medjool date cultivar seeds were influenced by pollen sources, as revealed by their physicochemical properties. However, certain parameters exhibited minimal variation. Notable differences were observed in the physical, proximate, and nutritional parameters when cvs. Khadrawy and Medjool pollens were utilized. On the other hand, the cv. Zahidi pollen source showed the most significant disparities in mineral content. These findings highlight the substantial impact of pollen source selection on the nutritional attributes of cv. Medjool date seeds, suggesting their potential suitability as functional food or as by-products in the date production industry (Salomón-Torres et al., 2020). Additionally, another study indicated that the cvs. Sheikhali and Fard exhibited the highest concentrations of glucose and fructose in the fruits. Moreover, these cultivars contributed to the enhanced breakdown of fruit chlorophyll, thereby improving the overall fruit quality. Based on the study's findings, it can be inferred that the utilization of pollen from the cvs. Fard and Sheikhali can have a beneficial impact on both the quantity and quality of cv. Piarom date fruits. This is attributed to the metaxenia properties exhibited by these cultivars (Shahsavar and Shahhosseini, 2022).

The productivity of date palm trees primarily depends on the proportion of fruit that develops from the flower strand. This outcome is influenced by several factors, including the origin and quality of the pollen used, the timing of pollination, the method employed, compatibility between male and female plants, as well as additional considerations such as temperature, fertilization, irrigation and soil characteristics (Salomón-Torres, 2017). The pollination of date trees is influenced by various factors, one of the most important being the pollen grains of different varieties of male trees, which have a significant effect on fruit formation, fruit characteristics and yield. (Iqbal et al., 2012) stated that the pollen grains exhibited variations in terms of their shape, size, length, diameter, weight, and germination percentage (Soliman and Al-Obeed, 2013). Different cultivars of male trees can be identified by quantitative characteristics that can be measured in pollen grains, but qualitative characteristics such as viability of pollen grains with different cultivars and female trees play a decisive role in proper fruiting (Djerouni et al., 2015). Pollen grains with different characteristics in length, diameter, and viability, which are genetically controlled, can lead to an improvement in fruit yield and characteristics (Al-Khalifa, 2006). Shafique et al. (2011) also reported that different pollen grains had significant effects on fruit shedding, yield, and some physical characteristics of the fruit.

During the blooming phase, male and female flowers of date palm trees exhibit several notable differences. The reproductive performance of these plants, including fruit quantity and quality, is influenced by several factors. Among these, the quality of pollen grains, which varies among male flowers, plays a significant role. Numerous researchers have conducted studies to explore the impact of different pollen sources on fruit formation, yield and physical attributes of the fruits (Mustafa et al., 2014). Fruit yield and quality in date palm cultivation can be enhanced by carefully selecting compatible pollen grains that effectively interact with female flowers. This approach is considered one of the most effective methods for increasing date productivity (Bishr and Desoukey, 2012). Whittlesey (1933) report that some pollen grains accelerate fruit ripening. Nixon (1934) proved that the pollen could accelerate the ripening of the fruit for 15 days compared to other pollen grains used. They concluded that pollens accelerating fruit ripening produced smaller fruits and seeds than other pollens used, and pollens that delayed fruit ripening produce larger fruits and seeds than other pollens. When climatic conditions are favorable, pollen grains of the tested male bases do not show the effects of metaxenia (Reuveni, 1986).

The Piarom date cultivar is characterized as a semi-dry variety that matures later compared to other cultivars. The elongated fruits of cv. Piarom measure approximately 3–5 cm in length. These dates exhibit a deep brown color and possess thin skin that tightly adheres to the flesh. This cultivar is cultivated in the north of Hormozgan province and Sistan-Baluchistan and is well-known worldwide and is highly suited for export to global markets. It is the most expensive cultivar among different date palm varieties, providing good profitability for growers. Given its global significance, improving the fruit quality can have a significant impact on increasing demand for this cultivar and it is possible to increase its quantity and quality by selecting and introducing suitable cultivars as pollinators (Mohammadpour Karizaki, 2017; Shahsavar and Shahhosseini, 2021). Therefore, it is necessary to identify, collect and protect male date palm cultivars

for pollination, and to improve the quantitative and qualitative properties of commercial and high-yielding cultivars. The objective of the current study has been to assess how the pollen source from various genotypes affects the fruit characteristics of the cv. Piarom date palm.

Materials and Methods

Plant Materials and Treatments

The present study was carried out during the 2021 and 2022 seasons on 20-year-old cv. Piarom date palms grown on sandy soil (pH = 8.7) under a flood irrigation system in a well-known orchard located in Bampour city, Sistan and Baluchestan Province, Iran. The selected palms were healthy, nearly uniform in growth, vigor and fruiting and received regular horticultural practices such as fertilization, weeding and pruning. This study included five treatments with four replications (each replicate consisted of one tree), and the treatments were five males as pollen grain sources: Spake, Meskotan, Fanoj, Grambit and Zaboli cultivars. In each tree, eight strands were selected considering a leaf-to-strand ratio of 12 1 and the rest of the strands were removed. Each treatment was performed on a single tree for each replicate. The spots were covered before opening. After opening the spot, the cover was removed, and pollination was performed. The spots were recovered immediately after pollination. For pollination from fresh pollen grains, after separating the male spots from the male date palms, six strands were placed upside-down in each female spot. The pollination time was chosen to be the same for all treatments (10 am). Two weeks after pollination, the cover was removed from the strands when pollination was not possible.

Measured Factors

Time of Fruit Ripening, Fruit Set, Parthenocarpic Fruits and Fruit Drop

To determine the effects of pollen grains on fruit ripening, the number of days from the time of pollination for each strand to the time when 80% of the fruits of each strand were in the ripening stage was calculated.

Six weeks after pollination from each strand, six strands from three different directions of each strand were randomly selected, the fruit set, triple parthenocarpic fruits and fruit drop were counted and the percentage of each was calculated.

$$\text{Fruit set \%} = Ns/Nt \times 100$$

$$\text{Fruit drop \%} = Nr/Nt \times 100$$

$$\text{Parthenocarpic fruits} = Np/Nt \times 100$$

where Ns = Number of setting fruits strand^{-1}, Nt = Total number of flowers strand^{-1}, Nr = Number of droped fruits strand^{-1}, Np = Number of parthenocarpic fruits strand^{-1}

Length, Diameter, Weight and Volume of Fruit and Seed

From each strand, ten fruits were randomly selected at the ripening stage, and the length and diameter of the fruit and seed were measured using a digital caliper. The weights of the fruit and seed were measured using a digital scale, and the volume of the fruit was measured using the water displacement method (AOAC, 1995).

Weight of Pulp, Weight of Fruits/Bunch, Weight of Parthenocarp Fruits, Bunch Weight and Yield

The weight of the pulp was obtained from the difference between the weight of the fruit pulp and the weight of the seed, and the percentage of fruit pulp was calculated.

At the end of the date stage, bunches of each tree were harvested and weighed on a digital scale. After the bunches were weighed, the formed fruits and parthenocarp fruits of each cluster were weighed separately. The yield of a tree was obtained by adding the weight of the fruits of the bunches of each tree (Siahsar et al., 2016).

SSC, TA, SSC/TA, and pH

To determine SSC randomly from each treatment, 4-5 fruits were collected, after which the slices were mixed and weighed using a laboratory digital scale. Owing to the high amount of date sugar, it was not possible to measure the total dissolved solids directly. Therefore, by preparing a mixture of fruit flesh with a certain ratio of water, the amount of dissolved solids was determined using a digital refractometer. For this purpose, 10 g of fruit pulp were added to 100 mL of distilled water and stirred for 10 min using a magnetic stirrer. The extract was then filtered with a filter paper, and the amount of dissolved solids was determined using a digital refractometer (model Erma-D, Japan) (Hosseini, 2006).

First, date samples were extracted according to the method described in the previous section. Then, in order to determine the total acidity, 10 mL of the sample extract, 20 mL of distilled water and 2-3 drops of phenolphthalein reagent were combined, and titration was performed using a burette and 0.1 N NaOH solution; when the pH of the solution reached 8.3, the appearance of a pale pink color (onion skin) stopped. The reagent used was phenolphthalein, which changed from colorless to purple at pH 8.3. The volume of the solution used was recorded for each sample, and considering that each milliliter of 0.1 N NaOH consumed is equivalent to 0.064 g of citric acid, the total acidity was calculated from the following formula (Baloch et al., 2006):

0.064 x volume of solution used for each sample = acidity level (in grams of citric acid per 100 g)

To measure the SSC to TA ratio, the data obtained from the SSC measurements were divided by the TA data.

For pH measurement, 10 g of date samples were added to the volume in a 100 mL flask with distilled water and stirred for 15 min in a shaker at 50 revolutions per minute. The obtained solution was passed through a filter paper and poured into a beaker, placed on a stirrer and the speed of the stirrer was adjusted to a medium speed so that the solution was mixed slowly and uniformly. The previously calibrated pH meter electrode was placed inside the sample, and the pH value was measured using a digital pH meter (Hosseini, 2006).

Statistical Analysis

The data obtained based on the randomized complete block design with four replications were analyzed using SAS software and the averages were compared using Duncan's test at a statistical level of $P < 0.05$.

Results

Fruit Set, Fruit Drop, Time of Fruit Ripening and Parthenocarpic Fruits

The type of pollen grain source was effective on the fruit set, so that the pollen of cvs. Fanoj and Zaboli had the highest percentage of fruit set compared to other treatments (57.24 and 57.15 %, respectively), which was 17.34% more than the lowest percentage of fruit formation related to Grambit pollen grains (Fig. 1).

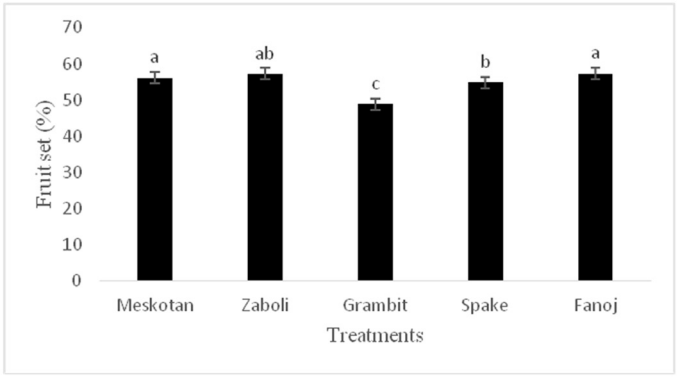

Figure 1. Effect of pollen grain treatments on fruit set. Means followed by different letters in columns are significant at $P < 0.05$ level (Duncan's test)

The highest fruit drop was observed in cv. Grambit pollen grains (41.16%), and the lowest fruit drop was found in cvs. Zaboli, Fanoj, and Meskotan pollen grains (33.63, 34.33, and 34.75%, respectively) (Fig. 2).

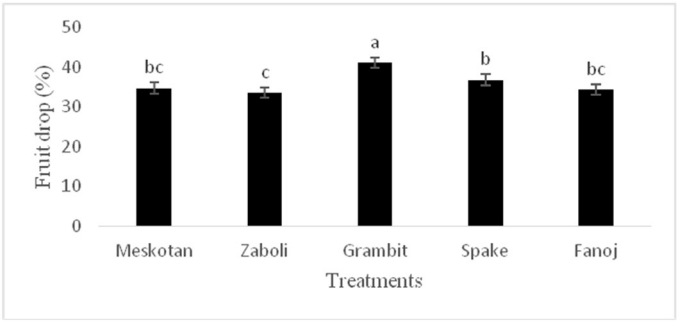

Figure 2. Effect of pollen grain treatments on fruit drop. Means followed by different letters in columns are significant at $P < 0.05$ level (Duncan test)

The results showed that the time of fruit ripening and the weight and percentage of parthenocarpic fruits on the Piarom dates were not influenced by different pollen grains.

Weight, Length and Diameter of Fruit and Seed and Fruit Volume

Zaboli and Fanoj pollen grains had the highest weight of fruits formed in the bunch (8.013 and 7.808 kg/ bunch, respectively), which was 27.6% more than the fruit formed by Grambit pollen that had the lowest fruit weight/bunch (6.275 kg bunch^{-1}) (Fig. 3).

The fruits of trees pollinated with cv. Grambit pollen grains had greater weight and volume, which was significantly different from the other pollen grains used (Fig. 4 and 5).

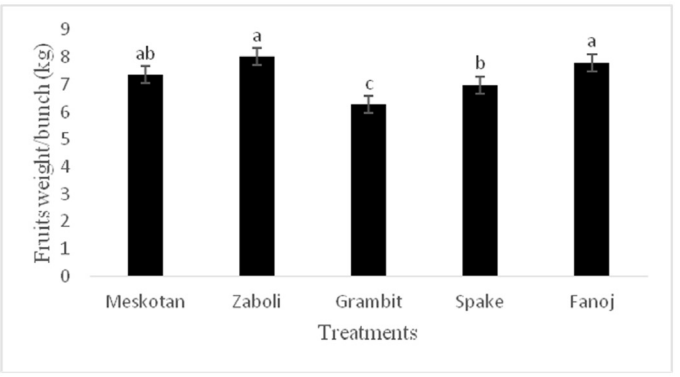

Figure 3. Effect of pollen grain treatments on fruits weight/bunch. Means followed by different letters in columns are significant at $P < 0.05$ level (Duncan test)

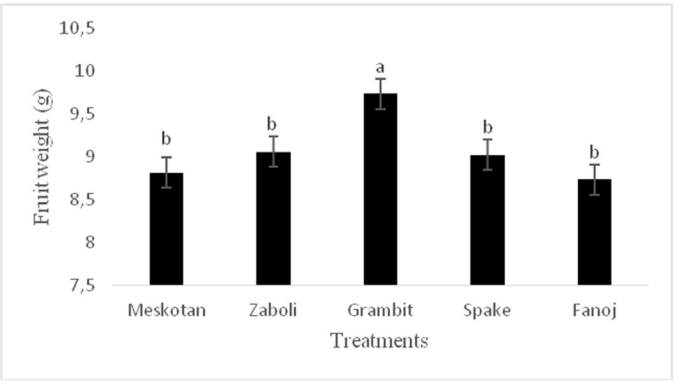

Figure 4. Effect of pollen grain treatments on fruit weight. Means followed by different letters in columns are significant at $P < 0.05$ level (Duncan test)

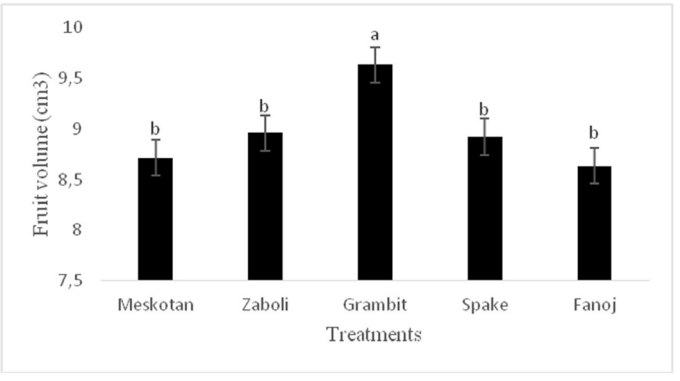

Figure 5. Effect of pollen grain treatments on fruit volume. Means followed by different letters in columns are significant at $P < 0.05$ level (Duncan test)

Based on this, the average weight and volume of the fruit pollinated with cv. Grambit were 9.7 g and 9.6 cm^3, respectively. Other pollen grains treatments (cvs. Zaboli, Meskotan, Fanoj, and Spake) had the same effect on fruit weight and volume.

The maximum fruit length was observed in fruits pollinated with cvs. Grambit, Zaboli and Spake pollinizers (4.59, 4.55, and 4.49 cm, respectively), and the lowest fruit length was related to pollination with cv. Fenuj pollen grains (4.31 cm) (Fig. 6).

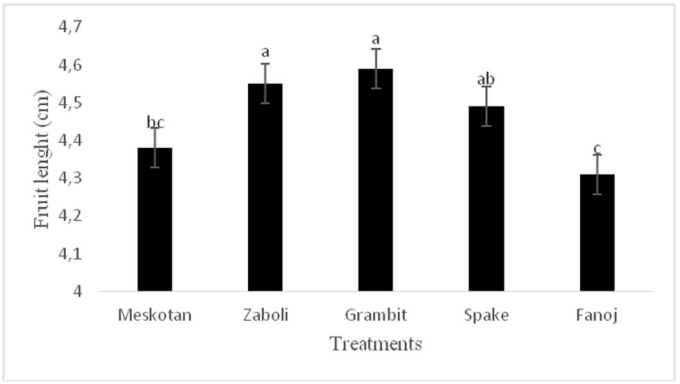

Figure 6. Effect of pollen grain treatments on fruit length. Means followed by different letters in columns are significant at $P < 0.05$ level (Duncan test)

The maximum fruit diameter was influenced by the Grambit pollen grain (1.79 cm), which was 27.4% greater than the smallest fruit diameter in fruits pollinated with the Fanoj pollen grain (1.62 cm) (Fig. 7).

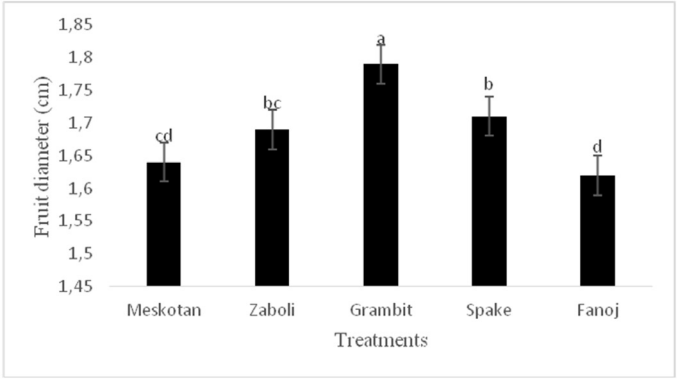

Figure 7. Effect of pollen grain treatments on fruit diameter. Means followed by different letters in columns are significant at $P < 0.05$ level (Duncan test)

Different pollen grains had no effect on seed weight, but had an effect on seed length and diameter. The maximum seed length was obtained with cv. Grambit pollen (2.78 cm) and the minimum seed length related to the Fanoj pollen treatment (2.67 cm) (Fig. 8).

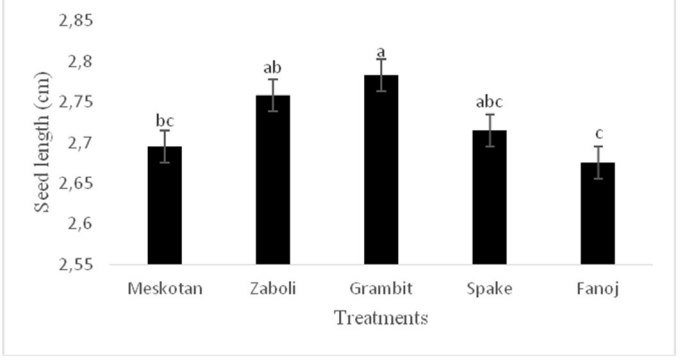

Figure 8. Effect of pollen grain treatments on seed length. Means followed by different letters in columns are significant at $P < 0.05$ level (Duncan test)

The fruits of the trees pollinated with cvs. Grambit and Zaboli had larger seed diameters (0.56, and 0.54 cm, respectively), and the fruits pollinated with cvs. Meskotan, Spake and Fanoj pollen seeds were ranked next (Fig. 9).

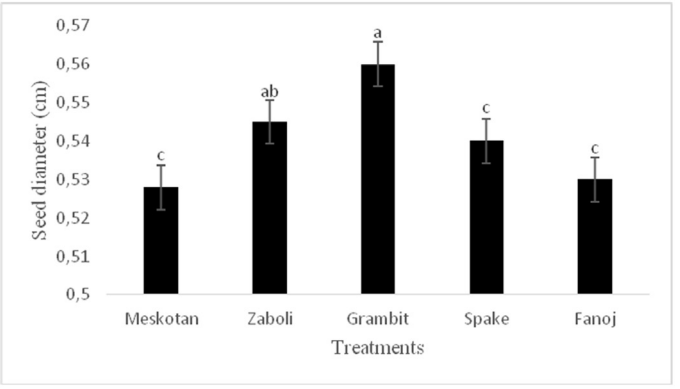

Figure 9. Effect of pollen grain treatments on seed diameter. Means followed by different letters in columns are significant at $P < 0.05$ level (Duncan test)

The highest weight of fruit pulp (8.718 g) was observed in the cv. Grambit pollen grain treatment, which was 12.34% greater than the weight of fruit pulp in the Fanoj treatment, which had the lowest pulp weight (Fig. 10).

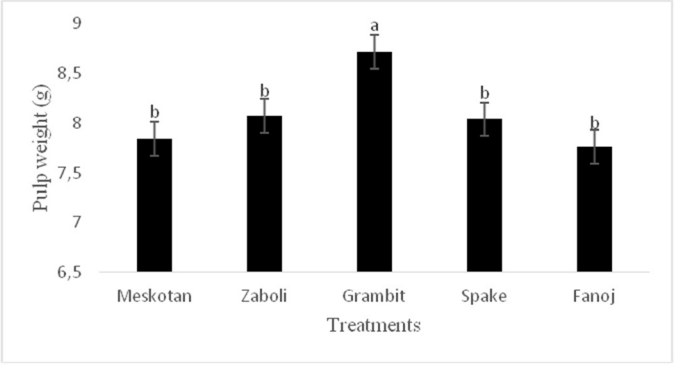

Figure 10. Effect of pollen grain treatments on pulp weight. Means followed by different letters in columns are significant at $P < 0.05$ level (Duncan test)

Bunch Weight and Yield

The highest bunch weight (9.302 kg) was produced by the use of cv. Zaboli pollen, which was 22.9% higher than the lowest cluster weight, which belonged to the treatment of trees pollinated with Grambit pollen (Fig. 11).

The highest yield of each tree was obtained with the use of cvs. Zaboli, Fanoj and Meskotan pollen grains (64.106, 62.464, and 58.836 kg tree^{-1}, respectively), and the lowest yield of each tree was observed in the cvs. Spake and Grambit treatments (55.874 and 50.198 kg tree^{-1}, respectively). In general, the yield increased by 27.7% when cv. Zaboli pollen was used compared to cv. Grambit pollen (Fig. 12).

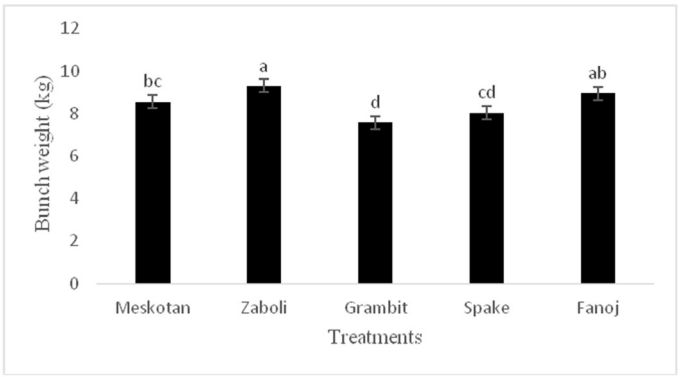

Figure 11. Effect of pollen grain treatments on bunch weight. Means followed by different letters in columns are significant at $P < 0.05$ level (Duncan test)

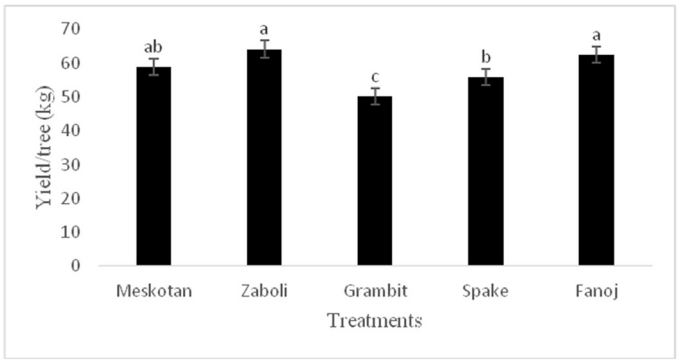

Figure 12. Effect of pollen grain treatments on yield tree^{-1}. Means followed by different letters in columns are significant at 5% level (Duncan test)

SSC, TA, SSC/TA and pH

The highest soluble solids content (68.61%) was obtained after treatment with Grambit pollen grains. Other pollen grains, including cvs. Meskotan, Zaboli, Spake, and Fanoj, had less soluble solids content, which ranged from 66.68 to 67.18 % (Fig. 13). The pollen grains used in this experiment did not affect the pH, TA, or SSC: TA ratio.

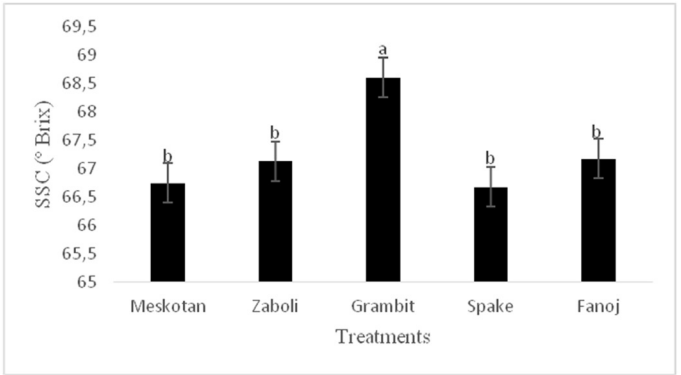

Figure 13. Effect of pollen grain treatments on SSC. Means followed by different letters in columns are significant at $P < 0.05$ level (Duncan test)

Discussion

The results of one study indicated that the pollen source had a metaxenia effect on fruit set, and this impact varied depending on the specific pollinator. These findings are consistent with previous research that highlighted the positive influence of pollen grains on both the percentage of fruit set and the overall date yield (Shafique et al., 2011; Al-Muhtaseb and Ghnaim, 2006). It has been determined that there is a direct relationship between the percentage of fruit set and yield; thus, with the increase in fruit set, the yield also increases (Al-Hamoudi et al., 2006). According to Khamis et al. (2010), variations in fruit set can be attributed to differences in pollen grain viability or compatibility. Islam (2017) further noted that the type of pollen had an impact on fruit formation, quality and yield, with the degree of influence being contingent upon the specific female cultivar. Fruit formation is influenced by multiple factors, including timing of pollination, duration of male tree flowering, type and viability of pollen, as well as the presence of female flowers.

The variations in crop yield may arise from factors such as the quality of pollen, percentage of germination and growth of pollen tubes. Successful pollination is associated with stigma acceptance time, and pollen can fertilize the ovule inside the ovary. Pollination time is an important factor in date yield (Duda and Ahmad, 2008; Wahab and Homd, 2014). Dates, like most other trees, have two waves of fruit drop; the first drop occurs a few weeks after pollination due to a lack of pollination or fertilization. Typically, the second shedding phase is characterized by heightened intensity and occurs within a 5-6 -week interval following the previous shedding. Physiological shedding, which is influenced by plant stress and ethylene production, is the underlying mechanism. The findings of this study align with those of Shafique et al. (2011) and other researchers. Shafique et al. (2011) report that the pollen source and frequency of pollination significantly impact fruit drop, yield and quality of Dhakki dates.

The increase in fruit weight and volume in the treatment with Grambit pollen grains may be due to the formation of less fruit, which increases the chance of absorbing more water and nutrients for the formed fruits because of less fruit in each strand. The fruit becomes coarse, resulting in an increase in its weight and volume. The most important difference between fruit growth and final fruit size is the presence of seeds that are formed as a result of fertilization of the fruit. Seeds are a rich source of hormones, such as auxins, gibberellins, and cytokinins, the most important of which is the absorption of photosynthetic materials made in the leaves into the fruit, especially in the early stages of fruit growth (Mortazavi et al., 2018).

The change in fruit weight in response to different pollen sources can be related to the effect of pollen on cell division and cell number in the early stages of fruit growth (El-Hamady et al., 2010). Sachmechi (2018) analyzed the pollen of Fard and Jarvis cultivars and genotypes 7003, 7006 and 7026 on Piarom dates and showed that different treatments on length, diameter, weight, ratio of length to diameter of fruit and seed, fruit volume, fruit flesh weight, flesh-to-seed ratio, percentage of fruit set and abortion, yield and cluster weight were significantly different, which is consistent with the results of the present study.

Mustafa et al. (2014) noted that the physical attributes of the fruit, including weight, volume, length, and diameter, as well as the biochemical properties such as organic acid, soluble solids, and total sugar content, were influenced by the type of pollen. Moreover, they found that the pollen grains had an impact on both the quantitative and qualitative characteristics of Shahani date fruit. This impact was evident in terms of fruit formation percentage, yield, length, diameter, weight, and volume of the fruit, as well as the pH and total acidity of the fruit juice. The ratio of flesh to seed and soluble solid content (SSC) were particularly significant factors (Khajepour Tadovani et al., 2015), which is consistent with the findings of the present study in terms of the effect on the percentage of fruit set, percentage of fruit drop, weight, volume, length and diameter of fruit, cluster weight and yield.

Ashour et al. (2008) reported that the length, diameter and weight of fruit were influenced by the type of pollen, which is consistent with the results of this study. This effect seems to be related to metaxenia. In fact, pollen increases the length and weight by affecting the growth of the ovary and embryo (Shafique et al., 2011). Pollination with different types of pollen affects the weight of the date fruit flesh (El-Hamady et al. 2010).

According to Omar et al. (2014), the choice of pollen source has a notable effect on fruit weight. This finding was consistent with the results reported by Simozrag et al. (2016). Additionally, Merwad et al. (2015) and Mustafa et al. (2014) observed that various pollen types affected the weight of date fruits, which is consistent with the obtained results.

Nixon (1934) proved that the pollen of Ferd No. 4 variety could accelerate the ripening of Deglet Noor variety fruit for 15 days compared to other pollen grains used. However, Reuveni (1986) concluded that when weather conditions are favorable, the pollen grains of the tested male bases did not show the effects of metaxenia. His results agree with some of the results of this experiment, including the lack of an effect of pollen grains on ripening time.

Faraq et al. (2012) in the study of the metaxenia effect of pollen grains on the total sugar content of date fruit stated that the total sugar content was affected by the type of pollen. The importance of the influence of pollen on fruit sugar content can be attributed to the metaxenaic role of pollen in the activity of hydrolytic enzymes such as polygalactronase in the dissolution of date fruit pectin (Hasegawa and Smolensky, 1971). Considering that most of the soluble solids in dates are related to sugars, the obtained results are consistent with the findings of Faraq et al. (2012).

Ramazanzadeh (2013) conducted an experiment to find a suitable male pollinating cultivar for the pollination of Borhi dates and reported that there was a significant difference between the fruit set and the length of the fruit of different pollinating cultivars, but most of the quantitative characteristics of the fruit, such as total acidity, total sugar, and sugar-to-acid ratio, were not significantly different. His results in this regard are consistent with the findings of the current research in terms of the non-significance of pH, total acidity and SSC/TA ratio. Tavakoli et al. (2014), Torres et al. (2017) report that pollen grains do not affect SSC and TA. However, based on the results of Shafique et al. (2011), the pollen type has a different effect on dissolved solids, which is consistent with the results of the present experiment.

Rahnama (2013) studied the effect of three types of date pollen seeds (Vardi, Samsavi and Ghanami) concluded that Vardi pollen significantly increased the inoculation percentage, number of seeds and yield, while the quality characteristics of the fruit, including sugar, TA and SSC, were not affected by this type of pollen, which is consistent with the results of the present study. Gupta et al. (2017) reported that there was no significant effect on TA under the influence of pollen type and different cultivars, which is consistent with the results of the present study. Studies have shown that using pollen from *Phoenix canariensis* Chabaud can improve the quality of cv. Khalas fruit by boosting production, fruit quality and early fruit ripening for approximately two weeks. Similarly, using an indigenous pollinizer to pollinate the cv. Khalas cultivar has been found to result in superior fruit set percentage, tamar fruit percentage, bunch weight, pulp weight, fruit moisture content and TSS content (Khalil Omar et al., 2014; Munir et al., 2020).

Conclusion

The highest percentage of fruit set and the lowest percentage of fruit abortion in Piarom dates were obtained using the pollen grains of cvs. Fanoj, Zaboli, and Meskotan, respectively. Based on this, the highest cluster weight and the highest yield were obtained, respectively, owing to the use of pollen from the male bases of cvs. Zaboli, Fanoj, and Meskotan. Therefore, to increase the yield, it is recommended to use cvs. Zaboli and Fanoj male pollen in the first degree and Meskotan pollen in the second degree for pollination of cv. Piarom date trees.

CRediT authorship contribution statement

Abdolrahman Irandegani: Implementation, Conduction, and Data collection. **Azam Jafari:** Study planning, Manuscript writing, English translation. **Ebrahim Saboki:** Study planning, Statistical analysis. **Mostafa Shirmardi:** Statistical analysis. **Heidar Meftahizadeh:** Manuscript editing

Declaration of Competing Interest

The authors declare no known competing financial interests or personal relationships to influence the work reported in this manuscript.

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